INSECT PESTS *of the Peach* in the Eastern States

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CONTENTS

	Page
Plum curculio	3
Description, life history, and habits	3
Control measures	5
Peach tree borer	9
Description, life history, and habits	9
Control measures	10
Lesser peach tree borer	16
Life history and habits	16
Control	17
Shot-hole borer	17
Description, life history, and habits	17
Control	18
San Jose scale	19
Description, life history, and habits	19
Control	20
Forbes scale	21
Terrapin scale	21
White peach scale	21
Oriental fruit moth	22
Life history and habits	22
Control measures	23
Peach twig borer	24
Control measures	24
Sucking bugs	25
Control	25
Aphids	26
Control	26
Spraying and dusting outfits	26
Insecticides	28
Lead arsenate	28
Oil sprays	28
Lime-sulfur	29
Paradichlorobenzene	29
Ethylene dichloride	29
Nicotine sulfate	30
Cryolite	30
DDT	30
Parathion	31
EPN	31
BHC	31
Zinc-lime spray for bacterial spot	31
Precautions	32
Avoid pesticide residues	32

NAMES OF PEACH INSECTS

COMMON NAME	SCIENTIFIC NAME
Black peach aphid	*Anuraphis persicae-niger*
Forbes scale	*Aspidiotus forbesi*
Green peach aphid	*Myzus persicae*
Green stinkbug	*Acrosternum hilaris*
Leaf-footed bug	*Leptoglossus phyllopus*
Related species	*Leptoglossus oppositus*
Lesser peach tree borer	*Synanthedon pictipes*
Oriental fruit moth	*Grapholitha molesta*
Peach tree borer	*Sanninoidea exitiosa*
Peach twig borer	*Anarsia lineatella*
Plum curculio	*Conotrachelus nenuphar*
Rusty plum aphid	*Hysteroneura setariae*
San Jose scale	*Aspidiotus perniciosus*
Shot-hole borer	*Scolytus rugulosus*
Southern green stink bug	*Nezara viridula*
Stink bugs	*Euschistus* spp.
Tarnished plant bug	*Lygus oblineatus*
Terrapin scale	*Lecanium nigrofasciatum*
Twice-stabbed ladybeetle	*Chilocorus bivulnerus*
White peach scale	*Pseudaulacaspis pentagona*

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INSECT PESTS OF THE PEACH IN THE EASTERN STATES

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PEACH trees and fruit are attacked by many different insects. Among the most important are the plum curculio, the peach tree borer, the San Jose scale, the oriental fruit moth, and sucking bugs. In the peach-growing regions of the United States east of the Rocky Mountains they are responsible for much of the insect damage that occurs. This bulletin gives a brief discussion of the biology and methods of control of each of these pests, as well as several other kinds of insects that may at times cause serious damage in restricted sections.

PLUM CURCULIO

The plum curculio, or peach worm, is the most serious insect pest that directly attacks peach fruit in the eastern part of the United States. The adult females injure the fruit by puncturing it for egg laying, and the result is a wormy peach (fig. 1). In addition, the adults of both sexes cause gnarly fruit by making punctures for feeding (fig. 2). When control measures are not used, sometimes over half the peaches are wormy or gnarled. Rupture of the skin for feeding or egg laying furnishes a place for the brown rot fungus [1] to enter. Many infections of brown rot in peaches start in this manner.

The plum curculio is a native American insect and is widely distributed east of the Rocky Mountains, being especially abundant as a peach pest in the Southern States. It is not known to occur west of the Rocky Mountains.

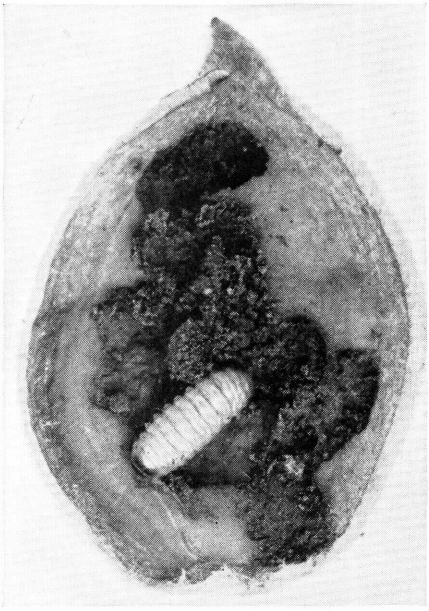

FIGURE 1.—Peach cut open, showing curculio larva and its work.

DESCRIPTION, LIFE HISTORY, AND HABITS

The adult insect is a hard snout beetle, about three-sixteenths of an inch in length, brown, mottled with gray. The egg of the curculio is whitish and rather elliptical, with a smooth, shiny surface. The full-grown larva, or grub, is about three-eighths of an inch in length and is yellowish white, with a brown head (fig. 1).

[1] *Sclerotinia fructicola.*

The insect passes the winter as an adult under leaves, grass, bark, sticks, and rubbish in woodlands adjacent to and near peach orchards and under grass and trash in the orchard or along terrace rows and fences. Bermuda-grass and Johnsongrass perhaps furnish the best hibernating quarters in southern peach orchards. The beetles usually begin to leave hibernation in the South before full bloom of the peach and are in the orchards in numbers by the time the trees are in full bloom. In the North the first beetles usually appear later, with reference to the blooming period, than in southern orchards.

In the South the beetles immediately begin feeding on the blooms, particularly the calyxes or outer flower parts, and to some extent on the unfolding leaves. As soon as the calyx splits, the females begin to deposit their eggs in small cavities just under the skin of the small peaches. Here the eggs hatch in from 2 to 12 days, depending on weather conditions, and the small larvae, grubs, or "worms," begin to feed on the flesh of the peach, in most cases boring into it until the pit is reached.

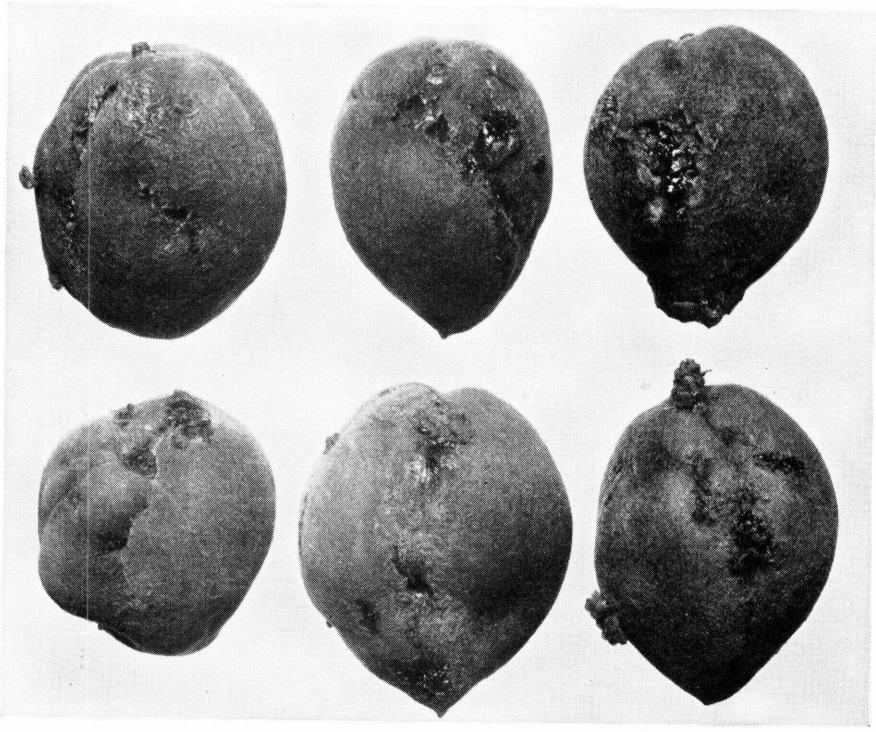

FIGURE 2.—Peaches gnarled as a result of egg laying and feeding of the plum curculio.

Most of the small peaches that are punctured by the curculio early in the season fall to the ground within a few weeks after the calyxes, or shucks, have been pushed off. The worms remain in the peaches, however, and after feeding for 2 weeks or more reach maturity, make their way out of the fruit, and enter the soil to transform into adult beetles. This

transformation takes place in a soil cell, constructed within 2 or 3 inches of the surface. The time spent in the soil as larva (in preparing the cell), pupa, and adult (before emerging) is from 30 to 35 days. In all, from 50 to 55 days is required, on an average, for the curculio to complete its life cycle from the laying of the egg to the emergence of the adult.

In the latitude of Virginia and southward two generations of the plum curculio usually occur in a season, especially if weather conditions permit the insect to develop rapidly. The second generation comes too late for varieties of peaches ripening before the Hiley, although as they ripen they may be attacked by curculios of the earlier generation that are still alive. The Hiley variety usually escapes injury by the second generation, although the last few pickings may show the presence of tiny second-brood larvae. Varieties ripening in the season of the Belle and Elberta and later are often severely attacked by the second generation. Second-generation beetles emerge from the soil during August.

In northern peach orchards only one generation of the plum curculio occurs each year. In an intermediate area, in the latitude of Delaware to Virginia, a partial second generation occasionally develops.

CONTROL MEASURES

Lead arsenate has long been recommended and widely used for control of the plum curculio. It is not always effective when the infestation is severe, and it may injure leaves, twigs, and even fruit to some extent, especially under humid conditions. Parathion is particularly effective, will not injure leaves, twigs, or fruit, and may also control other peach pests. EPN is about as effective against the curculio as parathion, to which it is closely related chemically. It will not injure trees or fruit, and will also control the oriental fruit moth, peach tree borers, and mites. *See* Precautions, p. 32.

The type of program to follow depends on the seasonal history of the insect in your area. In the South, where the curculios usually reach the trees in numbers by the time of full bloom, an insecticide applied when three-fourths of the petals are down will kill many of the beetles before they begin egg laying. In the North, where the beetles appear a little later with reference to the blooming period, the first application should be made correspondingly later. In areas where two broods occur, applications 3 to 5 weeks before the expected date of harvest may be needed for the control of the second brood or to prevent belated laying of the first-brood eggs.

Basic Spraying Program [2]

As a rule, spraying is more effective against the curculio than dusting, although dusting is more rapid. Growers are advised to use a spray if sufficient spraying equipment is available to cover their acreage in from 3 to 5 days. The accompanying table gives a basic spray program to aid the grower in developing a schedule for his particular orchard.

[2] The information relating to disease control was furnished by John C. Dunegan, pathologist, Horticultural Crops Research Branch, Agricultural Research Service. For more specific information on the various peach diseases and materials used for their control see Farmers' Bulletin 1527, Peach Brown Rot and Scab, and Farmers' Bulletin 2021, Growing Peaches East of the Rocky Mountains.

Basic Summer Spray Program for Control of the Plum Curculio

Application	Southern orchards		Northern orchards	
	Time	Material per 100 gallons of water	Time	Material per 100 gallons of water
First	When three-fourths of petals have fallen.	Lead arsenate 2 lb., zinc sulfate 2 lb., hydrated lime 8 lb. *or* Parathion (15-percent wettable) 2 lb. *or* EPN (25-percent wettable) 1½ lb.	When calyxes are being shed (about 10 days after petal fall).	Same as for southern orchards but to EPN or parathion spray add wettable sulfur as recommended on label.
Second	About 10 days after first application (when calyxes are being shed).	Same as first application plus wettable sulfur as recommended on label.	7 to 10 days after first application.	Same as first application.
Third	7 to 10 days after second application.	Same as second application.	7 to 10 days after second application.	Same as first application; if parathion or EPN is used, repeat 12 to 14 days later if infestation is heavy. Insecticide may be omitted if curculio infestation is very light.
Fourth	5 weeks before harvest *or* 4 weeks before harvest.	Parathion (15-percent wettable) 2 lb. plus wettable sulfur as recommended on label. Lead arsenate mixture or EPN same as first application plus wettable sulfur.	1 month before peaches are due to ripen.	Wettable sulfur as recommended on label; where curculio is difficult to control use lead arsenate mixture, parathion, or EPN, as in earlier applications.
Fifth	3 weeks before harvest (Not needed if lead arsenate program is used.)	Parathion plus wettable sulfur as in fourth application.		

Zinc sulfate and *hydrated lime* are added to lead arsenate spray to prevent arsenical injury. A spray containing these materials will also control bacterial spot (*Bacterium pruni*). For this purpose use 8 pounds of zinc sulfate and 8 pounds of lime per 100 gallons and make at least six applications at 2-week intervals beginning at the petal fall. If you use the zinc-lime spray for bacterial spot control throughout the season, use lead arsenate as the insecticide, as mixtures containing lime are not recommended for use with parathion or EPN.

Wettable sulfur is used to control brown rot and scab. Further applications of the fungicide alone may be necessary to protect the fruit from brown rot, especially on varieties maturing later than Elberta or during a wet season.

Parathion and *EPN* will help reduce scale and oriental fruit moth infestations.

Dusting

The time for making dust applications is the same as that given in the spray schedule. When lead arsenate is used, for the first two applications the dust should contain from 5 to 10 percent of lead arsenate in hydrated lime, and for later applications 80 percent of sulfur, 5 to 10 percent of lead arsenate, and 10 to 15 percent of hydrated lime. The formula containing sulfur may be used for all applications if desired. The percentage of lead arsenate to be used in the dust varies in different areas, but in Georgia as good control has been obtained with a 5-percent dust as with dusts containing higher percentages of lead arsenate.

A sulfur dust or a dust containing 80 percent of sulfur and 20 percent of hydrated lime may be used alone to give protection against brown rot. Late dustings should be light to avoid residues on the picked fruits.

Postharvest Treatment

When the curculio infestation during the peach season has been very heavy, a postharvest application of a spray or dust may protect the next peach crop by reducing the number of beetles before they go into hibernation. Two applications of cryolite, 4 pounds per 100 gallons of water, or a dust containing 10 percent of lead arsenate and 90 percent of hydrated lime should be used, the first application 4 weeks after harvest of the latest variety of peaches and the second 2 weeks later.

Supplementary Control Measures

Although spraying is the most effective single control measure, when unusually severe infestations develop it must be supplemented by other control measures if a large cull pile of wormy peaches at harvesttime is to be avoided.

Jarring

It is possible to collect many beetles in the spring by placing two large sheets under the peach trees and jarring the trees with a padded pole (fig. 3). Some growers have found this control measure very profitable, especially for trees near woodlands or other hibernating places where the beetles concentrate just after leaving hibernation in the spring. When the beetles are disturbed by the jarring, they fold their legs and fall immediately to the sheets, from which they can be collected or swept into a bucket of petroleum. The beetles are less active early in the morning than at any other time, and jarring is then most effective.

Collecting Drops

The most effective supplementary control measure in areas in which two broods occur is the collection and destruction of peach drops.

Since a majority of the small peaches that are punctured early in the season fall to the ground, the collection and destruction of drops prevents the development of many adult beetles (which otherwise would cause wormy peaches at harvest) and also leaves fewer beetles in the orchard after harvest to hibernate and attack the crop the succeeding year. About 90 percent of the worms that fall to the ground in peaches during the season can be destroyed if a first collection is made about 1 month after full bloom, or when enough drops to warrant a collection are down, and two others at intervals of 5 or 6 days. As soon as they are collected, all drops should be made harmless by being placed in sacks and submerged in water or put in boiling water.

FIGURE 3.—Jarring peach trees to capture adult curculios.

Disking Under Trees

Another supplementary control measure which fits in well with the usual orchard-management program is disking under the spread of the trees to destroy curculio pupae in the soil. If the soil cells constructed by the larvae are broken after they have changed to helpless, delicate pupae, the heat and pressure of the soil will kill many of them, and many others will be killed by exposure to the elements and to predacious enemies. The disking should be done weekly to a depth of several inches from about May 10 until the last of June in Georgia, and during later periods north of that State.

Eliminating Places of Hibernation

Since many curculios pass the winter as adult beetles in woodland and similar cover adjacent to and near peach orchards, cleaning up such places during the winter undoubtedly destroys some of the insects. As most of them hibernate within 100 yards of the orchard, the wooded areas need not be cleaned up beyond that distance. Vegetation on terrace rows and along ditchbanks and fences in and near the orchard should also be cleared out. Prunings, rubbish, and brush piles should not be allowed to remain in the orchard.

PEACH TREE BORER

Every year the peach tree borer directly or indirectly kills many peach trees of all ages in both home and commercial orchards. Although chiefly a pest of the peach, it sometimes does serious damage to cultivated plum trees and has been found breeding in wild plum, cherry, apricot, and related flowering varieties. The larvae feed on the cambium or growing tissues and inner bark of the tree (fig. 4), usually on the trunk just below the surface of the soil, although the larger roots are occasionally attacked. Young trees are sometimes completely girdled by the insect. Older trees are less likely to be completely girdled, but are often so severely injured that their vitality is lowered and their resistance to other insects and diseases is reduced. The work of borers is usually indicated by the presence of a mass of gum, particles of bark, and frass at the base of the tree (fig. 5).

FIGURE 4.—Peach borers in the trunk of a young peach tree. (Bark and gum have been cleared away.) About twice natural size.

DESCRIPTION, LIFE HISTORY, AND HABITS

The adult of the peach tree borer is a clearwing moth. The female (fig. 6, *B*) is dark steel blue, with one or two orange bands around the abdomen. The forewings are opaque, while the hindwings are clear except for the margins. The

male (fig. 6, *A*) is a little smaller, more slender, and a lighter steel blue than the female and has several narrow yellow bands around the abdomen. In the male both sets of wings are clear. The larva, or borer, when full grown is about 1 inch long, is yellowish white or cream colored, and has a dark-brown head.

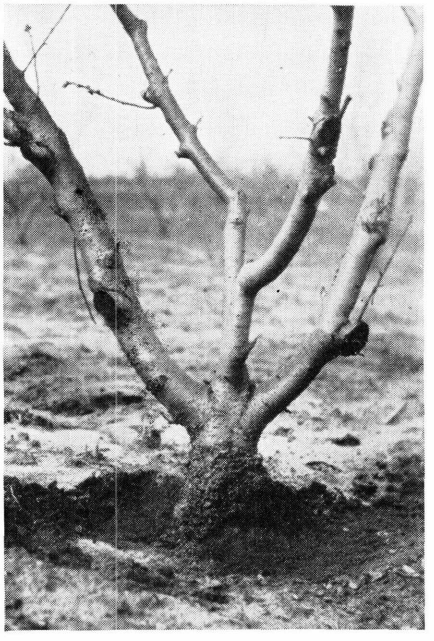

FIGURE 5.—Peach tree attacked at the base by the peach tree borer.

The winter is passed in the larval, or borer, stage. Some of the younger larvae live in a more or less dormant condition throughout the winter in a covering constructed on the bark of the tree outside the burrow, whereas all the larger ones pass the winter within their burrows in the bark of the tree and feed to some extent during warm periods. Upon maturity, the larvae change to pupae in silken capsulelike cocoons into which have been woven particles of bark and excrement, which give the cocoons a brownish color. They are usually near the surface of the soil, either at the head of the borer gallery or in the soil close to the tree trunk.

The pupal stage lasts 3 to 4 weeks, and then the adult moth emerges from the pupal shell. In the southern part of the Gulf States a few moths appear as early as May or June, but the heaviest emergence in the South occurs during August and September. In the North most of the moths emerge during July and August. Egg laying begins shortly after the moth emerges, but lasts only a few days. A female moth usually deposits from 500 to 600 eggs, mostly on the tree trunk, although some are placed on the limbs and leaves and even on weeds and soil near the tree. The length of the incubation period depends on weather conditions; the eggs hatch in 9 or 10 days in the summer.

Upon hatching, the larvae crawl or fall to the lower part of the tree trunk and usually enter it at the surface of the soil. They may bore directly into the bark or enter a crack in the trunk. Once inside, they feed rapidly on the bark layers and cambium of the tree and, with favorable feeding conditions, attain considerable size within a few weeks. There is generally only one generation annually.

CONTROL MEASURES

The peach tree borer may be controlled in three ways—(1) by spraying the trunk and lower portion of the larger branches during the period of moth emergence and egg laying to prevent infestation, (2) by placing paradichlorobenzene or ethylene dichloride on the ground around the trunk of the tree during the fall or in the early spring to destroy an established infestation, and (3) by worming—that is, removing the borers by hand—in the fall or early spring.

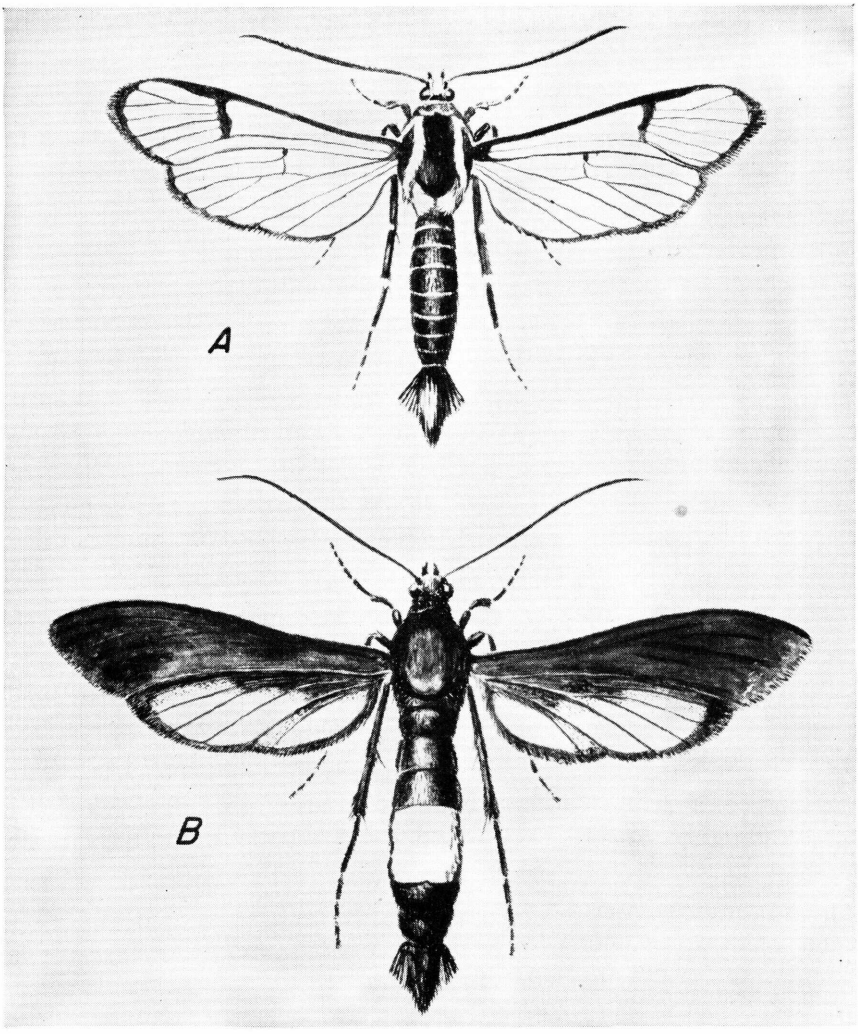

FIGURE 6.—Peach tree borer adults: *A*, Male; *B*, female. Two and one-half times natural size.

Spray Treatments

Several of the new insecticides may be applied as sprays to the trunk and lower portion of the larger limbs. The strength and timing of the sprays vary widely from one area to another. The materials most generally used, and the quantities per 100 gallons, include the following: DDT, 6 to 8 pounds of 50-percent wettable powder; parathion, 2 to 3 pounds of 15-percent wettable powder; BHC, 8 pounds of a wettable powder containing 6 percent of the gamma isomer. EPN, as recommended for control of the lesser peach tree borer, (*see* page 17), will also control the peach tree borer. *See* Precautions, p. 32.

In the latitude of Virginia and northward two applications are most commonly recommended, the

first between July 1 and 15 and the second about a month later or, if harvest interferes, soon after harvest is completed. Farther south three applications, the first July 10 to 15 and the second and third at 3- or 4-week intervals, are recommended. In Georgia four applications at 4-week intervals, beginning August 1, may be required.

Paradichlorobenzene Treatment

Paradichlorobenzene crystals have been used for peach tree borer control for more than 30 years. These crystals vaporize to form a gas, which penetrates the borer tunnels.

When To Apply

Best results are obtained by applying it in the fall at the end of the egg-laying period. At that time the borers are small and easily killed by the gas. The material should not be applied earlier on account of the possibility of an infestation becoming established later; on the other hand, the application should not be delayed too long because very little volatilization of the chemical takes place after the soil temperature drops below 60° F. The desired results cannot be expected unless the material is applied on or very close to the dates recommended in the following schedule:

Michigan, New York, and the New England States.	Aug. 25 to Sept. 10.
Southern lake region, New Jersey, Pennsylvania.	Sept. 15 to 25.
Ozark region, Ohio Valley, Maryland, Virginia, Delaware.	Sept. 25 to Oct. 5.
Northern Georgia, the Carolinas, Tennessee.	Oct. 5 to 15.
Central Georgia	Oct. 20 to 25.
Southern Georgia	Oct. 25 to 30.

Spring applications of the chemical give fairly satisfactory kills, although they allow the borers to feed in the trees until many are nearly grown and have done most of their damage. If it is desirable to apply a spring treatment, it should be given as soon as the ground begins to warm, the exact time depending on the locality.

How To Prepare the Soil

No preparation of the soil is necessary except to smooth the surface for about a foot from the tree trunk (fig. 7, *A*) with the back of a shovel before the chemical is applied. No soil should be removed, and the trees should not be mounded before the treatment unless borers are working in the tree trunk above the soil level. As the gas from the chemical is heavier than air, any borers working in the tree above the point where the ring of crystals is placed will not be affected. Consequently it is necessary to place the crystals at least at the level of the topmost borer gallery. Should there be indications of borers working in the tree trunk just above the soil level, sufficient soil should be placed around the tree to bring its level up above the gummy exudation before the chemical is applied.

How To Apply

Paradichlorobenzene should be applied in a continuous band about 1 or 1½ inches wide around the tree, and about 1 or 1½ inches from the trunk (fig. 7, *B*). Handy containers for applying paradichlorobenzene, holding exactly 1 ounce, can be obtained from insecticide dealers. The crystals should not be placed against the tree or too far from it. For trees of average size 6 years of age and older, 1 ounce should be used per tree; for unusually large trees, 1½ ounces or more is sometimes needed; for trees 4 and 5 years old, three-fourths of an ounce is sufficient; and if trees from 1 to 3 years of age are to be treated, from one-fourth to

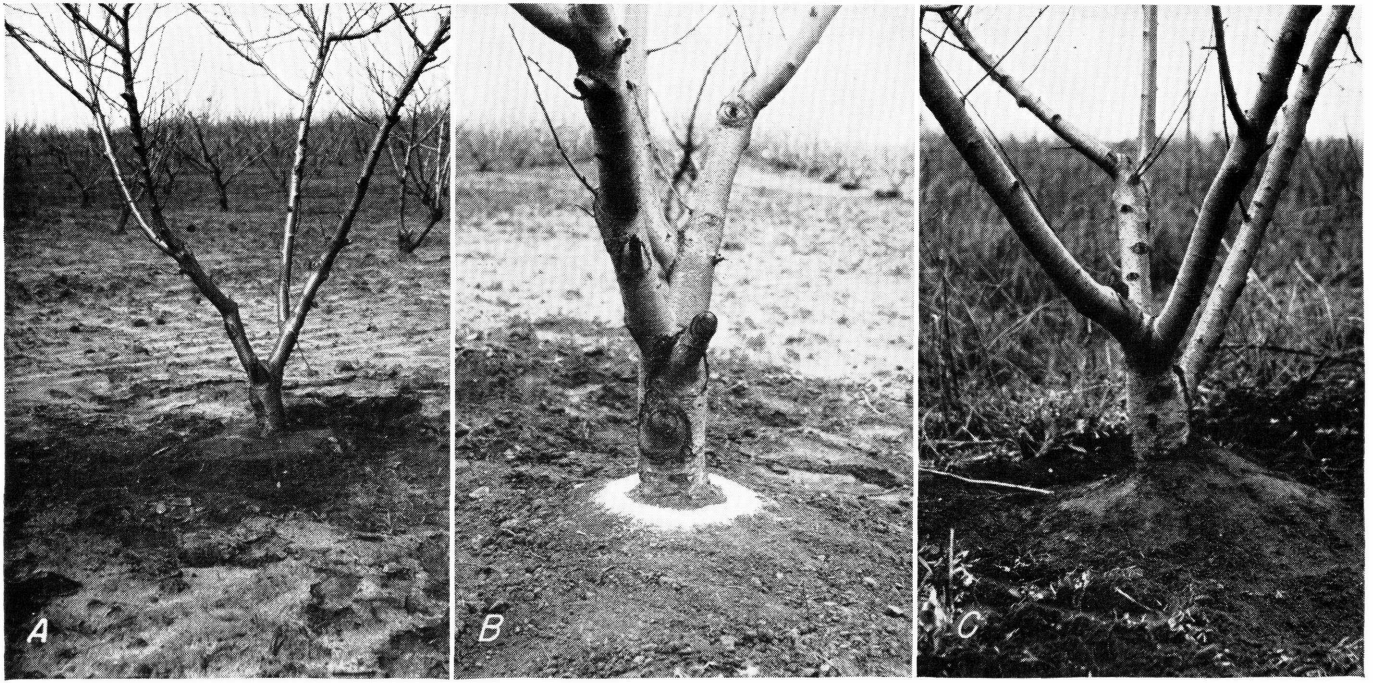

FIGURE 7.—Steps in the correct method for treating trees with paradichlorobenzene: *A*, The soil around this peach tree has been made ready for treatment; *B*, the ring of crystals should be from 1 to 1½ inches wide and from 1 to 1½ inches from the tree trunk; *C*, several shovelfuls of soil should be placed on top of the ring of crystals and packed gently with the back of a shovel.

one-half ounce should be used. After the chemical is in place, several shovelfuls of soil free from stones, sticks, and trash should be placed over it in the form of a low cone-shaped mound and packed with the back of a shovel (fig. 7, *C*). This mound serves to hold the gas and to prevent surface washing of the crystals. The packing of the soil after it is placed on the chemical is important to prevent surface loss of the gas. When the crystals are being covered, care should be taken to avoid pushing them against the tree trunk with the first shovelful of soil.

When paradichlorobenzene has been used around peach trees 4 to 5 years old, growers are advised to remove the mounds about 4 weeks after applying the chemical so that all unspent crystals will be away from the tree trunks and the confined gas will escape. It is also advisable to tear down the mounds 6 weeks after making the application to trees 6 years of age and older. If the soil is removed from below the original soil level in tearing down the mounds, it should be replaced before cold weather sets in.

Late in the spring or early in the summer it is well to level off the mounds remaining from the previous season's treatment, if this has not been done earlier. This prevents the new generation of borers from entering the trees high up on the trunk, where it would be impractical to make subsequent applications of paradichlorobenzene.

Injury From the Chemical

Under certain conditions paradichlorobenzene may cause injury to peach trees. Damage of this kind has been particularly serious on trees from 1 to 3 years old in the southeastern part of the country. Trees 4 years of age and older have sometimes suffered slight injury, but this has rarely proved serious. The treatment has caused serious injury to peach trees in the nursery and is therefore not recommended for nursery stock.

Ethylene Dichloride Treatment

Ethylene dichloride has been found very effective against the peach tree borer and has the advantage of being comparatively safe on young trees when applied at the proper strength. It can be used in colder weather than paradichlorobenzene and is easier to apply because it is a liquid. Stock emulsions of this material may be obtained from insecticide manufacturers or dealers, or they may be prepared on the farm in accordance with the directions given on pages 29–30.

The stock emulsion should be diluted with water before it is applied to the trees. The strength of the diluted emulsion will depend on the age of the trees, as shown in the accompanying table.

Dilution and dosage of ethylene dichloride emulsion for trees of different ages

Age of trees (years)	Strength of diluted emulsion	50-percent stock emulsion to make 10 gallons of diluted emulsion	Diluted emulsion for each tree
	Percent	*Gallons*	*Pints*
4 and older [1]	20	4	½
3	15	3	½
2	15	3	¼
1	7½	1½	⅛

[1] Unusually large trees may require more than ½ pint.

When and How To Apply the Emulsion

Ethylene dichloride emulsion may be applied for the control of the peach tree borer at any time during the fall or spring, and in the

South applications made in warm periods during the winter give good control. Best results probably are obtained in the fall at the end of the egg-laying period of the peach tree borer moths, when most of the borers are small. The use of the material in extremely hot weather should be avoided, since injury to the tree is more likely to occur at high temperatures.

No preparation of the soil before treatment is necessary on loose, level ground. In some cases, however, cupping the soil slightly toward the tree trunk to prevent the liquid from running off, or loosening the soil around the tree sufficiently to permit the liquid to be readily absorbed gives better results. Any cracks in the ground around or extending out from the tree trunk should be filled with soil before treatment, to avoid undue concentration of the material on any part of the root system, which might thus be injured.

The material is applied, either by pouring or spraying it on the soil around the base of the tree in such a way that the soil will absorb and hold it around the tree at the ground line. It should not be poured or sprayed on the trunk.

The quantity applied should be regulated rather closely, since applications much in excess of the suggested dosage may cause tree injury. A tin household measuring cup holding one-half pint, with marks for one-eighth and one-fourth pint, will be found useful for applying the emulsion (fig. 8).

FIGURE 8.—Applying ethylene dichloride emulsion by pouring. A household measuring cup with a short handle is being used.

A bucket pump may be employed for applying the ethylene dichloride, and with a little practice the quantity delivered to each tree can be regulated without difficulty. A power sprayer equipped with a device for regulating the quantity applied may also be used for this purpose. The stock emulsion should be thoroughly stirred before any is taken from the container for dilu-

tion, and the diluted emulsion should likewise be agitated before each dose is withdrawn for use around the tree. Each bucket of diluted emulsion should be provided with a paddle for agitation in cases where the application is made by pouring. Broken-down emulsions should not be applied, as the portion consisting chiefly of ethylene

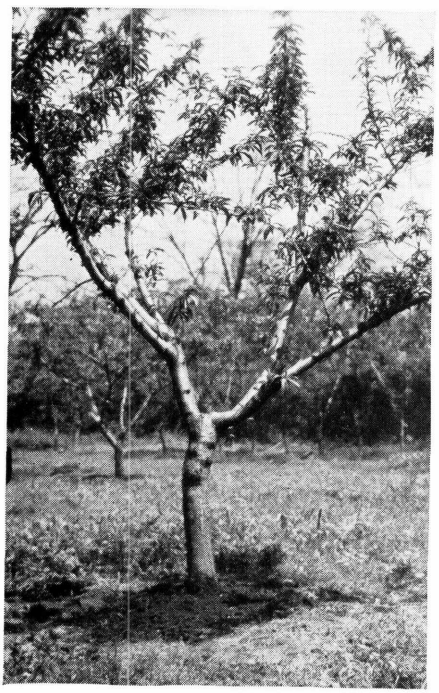

FIGURE 9.—The ethylene dichloride emulsion treatment completed. A little soil has been placed over the treated surface to prevent loss of the material.

dichloride may cause serious injury to the tree.

After the chemical has been applied, several shovelfuls of soil should be placed against the tree to prevent evaporation from the surface (fig. 9). The treatment needs no further attention.

Worming

For many years peach growers wormed their trees to protect them from the peach tree borer. If carefully done, worming keeps the insect in check reasonably well, but borers are often missed, and the injury to the tree from worming instruments may be more severe than that from the insect.

In preparation for worming, the soil is removed from the base of the tree to a depth of 6 or 8 inches. The borers are then removed with a sharp hawk-billed knife. The incisions should be made vertically, if possible, and care should be exercised not to injure or cut any more of the sound wood than is actually necessary in removing the borers or crushing them in their burrows. After the tree has been wormed, the soil should be replaced around it to decrease the possibility of injury from freezing weather.

Worming is made easier by heaping up the soil into a mound around the tree early in the summer, so as to cause the borers to enter the tree higher up than they normally would.

LESSER PEACH TREE BORER

The lesser peach tree borer is similar to the peach tree borer, but it attacks chiefly the trunk and limbs. The insect is invariably found working in areas of the tree that have been injured by implements, trace chains, cankers, low temperatures, or sun scald, and in crotches or under loose bark of old trees.

LIFE HISTORY AND HABITS

Like the peach tree borer, the lesser peach tree borer passes the winter in the larval stage. Early in the spring the overwintered larvae change to pupae and then to the adult moths, which deposit eggs along the trunk and limbs of the tree. A second brood of moths occurs late in summer in the South, but only one generation occurs farther north.

CONTROL

The lesser peach tree borer can be controlled in northern peach orchards by spraying the trunk and lower part of the larger limbs thoroughly with parathion or EPN first, about 1 month before the time recommended for the first application for the peach tree borer, and later at the times recommended for the peach tree borer. Use 2 pounds of 15-percent parathion or 25-percent EPN wettable powder to prepare 100 gallons of spray. If either of these insecticides is used to control the plum curculio, the first application for the lesser peach tree borer will not be needed. *See* Precautions, p. 32.

As the insect chooses for attack injured or diseased areas on the trunk and branches, be careful not to injure the trees with implements while cultivating. Wounds on peach trees should be given prompt treatment, and the trees should be kept in a clean and healthy condition by proper orchard management and fertilization. Limbs broken during peach harvest or killed by low temperatures during the winter should be promptly removed. Cankers and areas killed by sun scald should be cut out [3] before they become infested with the lesser peach tree borer.

SHOT-HOLE BORER

Attack by the shot-hole borer, sometimes called the fruit-tree bark beetle, may be recognized by the presence of tiny holes in the bark about the size of small shot. These are exit and entrance holes made by the adult beetle. The branches of injured peach trees often exude quantities of gum (fig. 10) from such holes. The shot-hole borer chiefly attacks trees that have been weakened by the attacks of other borers or scale insects, winter injury, drought, disease, unsuitable soil conditions, or mechanical injury. The insect, however, will attack healthy trees that are near severely infested ones in which the beetles have bred in large numbers.

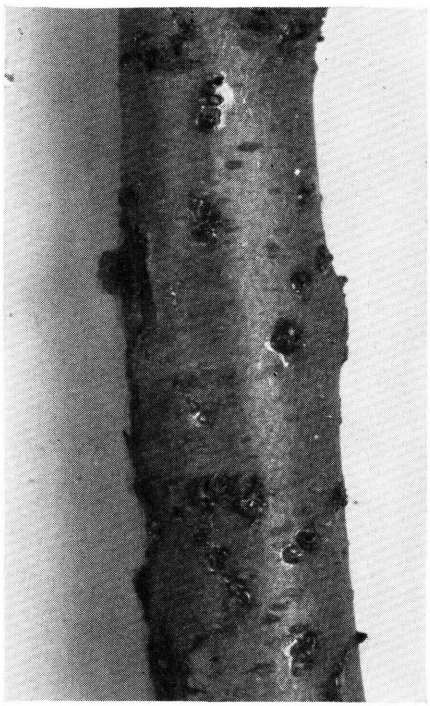

FIGURE 10.—Peach limbs attacked by the shot-hole borer, showing gum exuding from holes made by the insect.

DESCRIPTION, LIFE HISTORY, AND HABITS

In the spring the small, black beetles appear on the trees. They eat out channels between the bark and cambium layer and in these deposit their eggs. The eggs hatch after several days, and the tiny, white borers feed for about a month in burrows under the bark and then transform into the adult stage.

[3] For further information on the treatment of the wounds and other injuries of trees see Farmers' Bulletin 1726, Treatment and Care of Tree Wounds.

Soon after emergence the beetles begin to deposit eggs for another generation. There are from one to four generations each year, the larger number occurring in the South. The winter is passed in the larval stage under the bark.

CONTROL

Since the shot-hole borer usually restricts its attack to weakened trees, the best means of controlling it is to do everything possible to keep the trees in a high state of vigor. This involves pruning, cultivating, and fertilizing the orchard in accordance with the best horticultural practices. The elimination of breeding quarters is also important in controlling this insect. Peach trees that have been too seriously devitalized should be pulled up and burned. When only individual limbs are affected, these should be removed. Wild fruit trees and seedlings that may be furnishing breeding places for the insect near an orchard should also be removed. Prunings should not be allowed to remain on the ground in an orchard very long after they are cut, as the insect may breed in them.

Danger of attack by the shot-hole borer can be lessened by the application of a thick coat of whitewash (fig. 11). Although it has little effect on borers already in the trees, it has a tendency to repel the adult beetles, thus preventing the laying of eggs. Spraying infested limbs or trees with DDT, 2 pounds of a 50-percent wettable powder or its equivalent to 100 gallons of water, will kill the adult beetles, if the application is made when they are present.

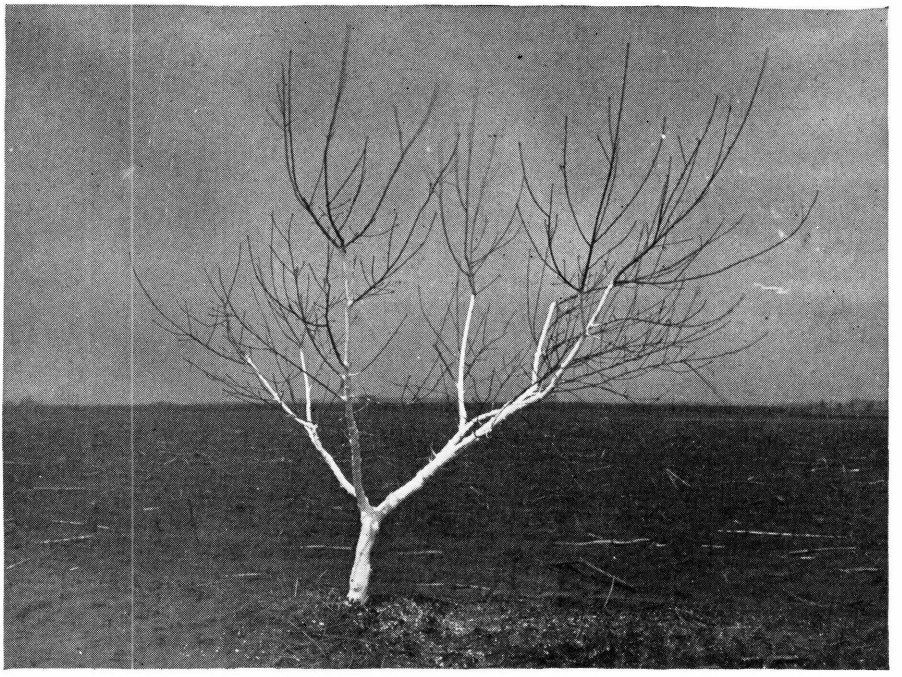

FIGURE 11.—A thick coat of whitewash applied to a peach tree to prevent threatened attack by shot-hole borers.

SAN JOSE SCALE

The San Jose scale is a pest of peach, apple, pear, plum, and other deciduous fruit trees, as well as many other plants. It takes its nourishment by sucking the sap from the trees, and in this way is directly responsible for the death of many peach trees each year.

The first indication of injury to peach trees from this scale is the killing of limbs or branches (fig. 12). An incrusted branch is readily distinguishable by its characteristic grayish appearance (fig. 13) and by the yellow, oily secretion seen when the scales are scraped off with a knife. The presence of a heavy infestation of the San Jose scale often causes a pitted, diseased condition of the wood, which may result in the exudation of droplets of gum. The feeding of the insect frequently stunts and weakens a peach tree to such an extent that it is especially subject to attacks by other pests.

DESCRIPTION, LIFE HISTORY, AND HABITS

In most localities the San Jose scale passes the winter in a partly grown condition, resuming growth in the spring and reaching maturity early in the summer. The full-grown scale is a tiny object, about the size of a pinhead, with an ashy-gray appearance. The insect itself is a small, orange-colored, legless insect, living underneath the scale covering, which is formed chiefly from exudations from the insect. Early in the summer the young scales appear. These are very tiny, active, yellow crawlers, which move around over the tree for a few hours

FIGURE 12.—Peach tree injured by the San Jose scale. Several branches have been killed.

looking for a place to attach themselves. When a suitable place is found, the crawler sends its long threadlike beak into the tree for the purpose of sucking out the sap for food and never moves thereafter from the place of attachment. The waxy covering begins to develop over the insect as soon as it settles.

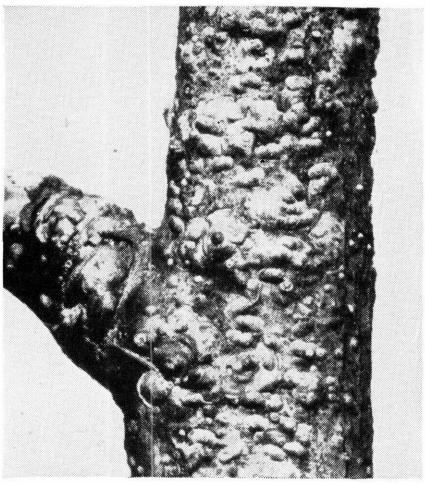

FIGURE 13.—A peach twig infested with the San Jose scale. Five times natural size.

Within 5 or 6 weeks after birth the females begin to reproduce. A female scale gives birth to an average of about 400 crawlers. The number of generations a season ranges from two or more in the North to six or possibly more in the South. Except during unusually cold winters, reproduction is more or less continuous in the South, and crawling young or newly settled scales may be found in the orchard at any time of the year.

The San Jose scale is preyed upon by a number of natural enemies. The twice-stabbed ladybeetle is usually abundant on peach trees that are heavily infested with this scale. It is jet black with two orange or red spots on the back. It sucks out the contents of the bodies of the scale insects.

CONTROL

The San Jose scale may be controlled by thorough spraying with either lime-sulfur or an oil emulsion. Since the insect does not eat the leaves or bark, the spray must be one that will kill by direct contact. Therefore, the spray must hit every side of the trunk, lateral limbs, and branches. The spraying must be done during the dormant season, when there is no foliage on the tree and when the budwood is seasoned for winter weather.

Lubricating-oil emulsions should be used at a strength of 3 percent of actual oil, and emulsible oils at the strength recommended on the manufacturer's label. Lime-sulfur (32°–33° Baumé) should be used in the proportion of 1 part to 7 parts of water.

The oil sprays are usually a little more effective than lime-sulfur; and, since they are not caustic, orchard workers are more likely to do a thorough job of spraying with them. Lime-sulfur, however, has the advantage of being also a fungicide. *Lime-sulfur should never be applied in the South until after two or three killing frosts have occurred, if injury to budwood is to be avoided.*

In some areas peach leaf curl is prevalent and requires treatment. Lime-sulfur at the strength required for the control of the San Jose scale, or even at half that strength, applied during the dormant period, is effective for leaf curl control. Oil sprays as a rule have little value for this purpose. Lubricating-oil emulsion may be combined with a 4–4–50 bordeaux mixture (4 pounds of copper sulfate and 4 pounds of lime in each 50 gallons of water) for the control of both leaf curl and scale. Some of the emulsible oils do not combine well with bordeaux mixture; the advice of the manu-

facturer should be sought if there is any question.

San Jose scale can also be controlled with parathion applied during the growing season. The minimum effective parathion spray program that will control this scale has not been determined, but good control has been obtained with three or more applications of ½ pound or two or more applications of 1 pound of 15- percent parathion wettable powder to 100 gallons of water when crawlers are present. *See* Precautions, p. 32.

Limbs that have been killed by a heavy scale infestation should be removed and the tree pruned, if possible, before the dormant spray is applied. Peach trees that have been weakened by the San Jose scale should receive a fertilizer high in nitrogen the following spring to promote the growth of budwood. If an incrusted infestation of scale has stunted and greatly weakened a peach tree, it would be well to remove it during the winter and to replant.

FORBES SCALE

Forbes scale is now often found on deciduous fruit trees, including peaches, alone or in association with San Jose scale. It is similar to San Jose scale in its general appearance, habits, and control. Parathion in dosages recommended for San Jose scale is effective in controlling Forbes scale. *See* Precautions, p. 32.

TERRAPIN SCALE

The terrapin scale (fig. 14) has been found on fruit trees in all the Southern States and in a number of Eastern States, although it is seldom a pest of major importance, except in the middle Appalachian region. Its presence is indicated by the sooty condition of the fruit, twigs, and leaves, caused by the growth of a black fungus on the honeydew excreted by the insect. This sooty fungus renders the fruit unsalable. The insect injures the tree in a manner similar to that of the San Jose scale, although it seldom directly causes the death of the tree. The scale covering, which resembles somewhat the shell of a terrapin, ranges in color from black to red and has a slightly ridged edge.

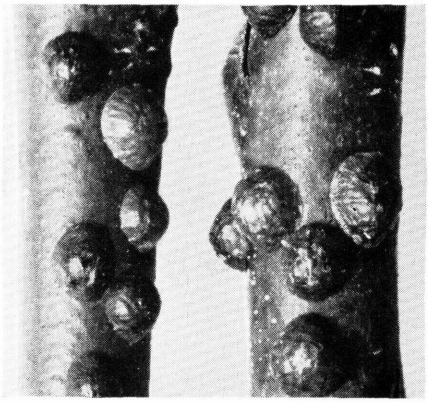

FIGURE 14.—The terrapin scale on peach twigs. About twice natural size.

Lubricating-oil emulsion applied as recommended for the control of the San Jose scale but used at a 4-percent strength (12 gallons of a stock emulsion containing 66⅔ percent of oil to 188 gallons of water) is effective for the control of the terrapin scale. The emulsion should be applied during the winter while the trees are dormant. Lime-sulfur is apparently ineffective against the terrapin scale.

WHITE PEACH SCALE

The white peach scale, or West Indian peach scale, has been found in a number of localities, chiefly in the South. On peach trees it is sometimes as injurious as the San Jose scale. It also attacks cherry and other stone-fruit trees.

The females are circular and brownish white. The males, which are usually found in clusters, are elongated and pure white (fig. 15). There are four or five generations annually in the South.

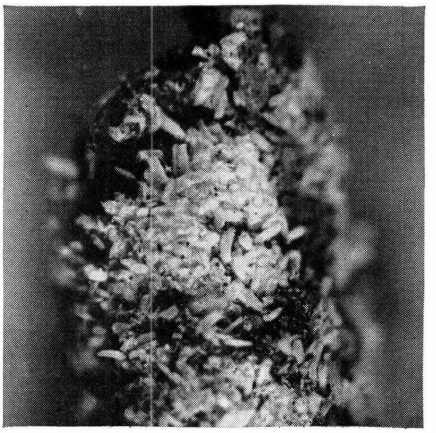

FIGURE 15.—A mass of white peach scales consisting chiefly of males. Four times natural size.

A 3-percent lubricating-oil emulsion applied during the dormant period is effective, and winter-strength lime-sulfur has also been used successfully against this insect. Two applications may be required to clean up an infestation.

ORIENTAL FRUIT MOTH

The larva of the oriental fruit moth damages both the twigs and the fruit of the peach. The twig injury, which occurs chiefly in the early part of the season, may interfere seriously with the growth of young trees, giving them a stunted, bushy appearance. The injury to the fruit is somewhat similar to that caused by the larvae of the plum curculio. Many of the peaches infested by the oriental fruit moth show no external evidence of injury. Inability to cull out all the damaged peaches results in serious complaints from housewives who discover the worms.

As the name implies, this insect is believed to be of oriental origin. It was first discovered near Washington, D. C., in 1915 and has since spread to practically all peach-producing sections. Its importance varies in different localities and from season to season. In the latitude of central and southern Georgia, where very little fruit of any kind is available after midsummer, the fruit moth is rarely a serious pest because the hardened twigs, upon which the fruit moth larvae must feed in the absence of fruit, are not very suitable food for them.

LIFE HISTORY AND HABITS

The oriental fruit moth passes the winter as a larva, or worm, in a cocoon in a crevice in the bark of the tree, in a dried-up peach, or in trash on the ground. With the first warm weather of spring, the insects undergo a transformation, and by the time of peach bloom, or a little later, the inconspicuous gray moths appear and lay their eggs, chiefly on the under side of the leaves. During the spring and early part of summer, when the new growth of peach trees is tender, the larvae enter the new twigs at the tip near the base or the axil of a leaf and eat out the center of the twig as they work downward (fig. 16). One larva may enter several twigs before it becomes mature. Heavy infestations of the oriental fruit moth may cause a tree to take on a bushy appearance because of the growth of secondary shoots after new terminal growth is destroyed early in the season. When the twigs harden in midsummer, the larvae cease working in them and start feeding in the fruit (fig. 17). They enter the fruit either from the side near the stem, or through the stem, and injure it much as do the curculio larvae. Full-grown larvae of the

fruit moth are usually pink, whereas curculio larvae are creamy white. The number of generations annually ranges from three in the New England States to six or more in south-central Georgia.

CONTROL MEASURES

Sprays

Sprays containing 2 pounds of 50-percent DDT, 1½ pounds of 25-percent EPN or 2 pounds of 15-percent parathion wettable powder per 100 gallons of water will protect twigs and fruit from the oriental fruit moth. To prevent injury from the first-brood larvae, make three applications 10 to 12 days apart beginning at the petal-fall or shuck-split stage of fruit development. To control second- and third-brood larvae, apply one spray 7 to 8 weeks and another 3 to 4 weeks before harvest. Control of the first brood may give control for the entire season in orchards not subject to reinfestation from nearby untreated orchards. Many growers have protected their fruit from injury with only the applications suggested for controlling the second and third broods.

Do not spray fruits later than 3 weeks before picking. Scrub or peel sprayed fruits before eating them. *See* Precautions, p. 32.

Control With Parasites

A number of parasites that attack the oriental fruit moth have been brought in from southern Europe, Japan, and Australia and colonized in practically all the important peach-producing areas in the United States where the fruit moth is a problem. In many areas the results have been very favorable, and the damage by this insect has been very much reduced. In some areas, however, the parasites have been of much less benefit. The most valuable parasite is *Macrocentrus ancylivorus*, which is native to the United States, and this species has predominated in the colonization releases.

In the region in which *Macrocentrus ancylivorus* is known to be most effective—roughly Massachusetts to Michigan and southward to eastern Missouri, Arkansas, and northern Georgia—growers who

FIGURE 16.—Tip of peach twig injured by the feeding of a larva of the oriental fruit moth within the twig.

are not equipped to spray can prevent nearly half the damage caused by the oriental fruit moth by making liberations each year when second- or first- and second-brood worms are present. In southern New Jersey the most favorable period for first-brood liberations is usually about May 20 to June 10, and for second-brood liberations June 25 to July 15. Southward it is earlier, and northward or at higher elevations it is somewhat later.

If liberations are concentrated against second-brood worms, release six females per tree, preferably five times at 4-day intervals. Start releases as soon as the first wilted twigs caused by this brood are observed. When liberations are to be made against both the first and second broods, use half the total number of parasites against each brood. Scatter the parasites widely over the orchard by walking slowly about carrying the shipping containers and opening them to permit the parasites to fly away.

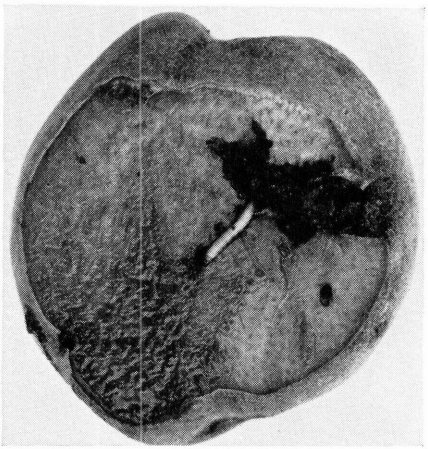

FIGURE 17.—Larva of the oriental fruit moth working in a peach.

Information on commercial producers of parasites can be obtained from your State experiment station or from the Oriental Fruit Moth Research Laboratory of the U. S. Department of Agriculture, Moorestown, N. J.

Other Measures

Paradichlorobenzene, when used for the control of the peach tree borer, will also kill larvae of the oriental fruit moth hibernating in cocoons on the trunks of peach trees at or near ground level. Fertilizers should not be applied late in the season, since they might promote new twig growth that would permit the insects to increase just before hibernation. Picking up and destroying dropped fruit infested with the larvae will reduce the infestation, and culls should be promptly removed from the sheds and buried.

PEACH TWIG BORER

The peach twig borer occurs generally throughout the peach-growing areas of the United States, but it seldom does much damage in the Eastern States. The larva injures the twigs and fruit in much the same manner as does the oriental fruit moth (fig. 16). Occasionally the damage done to the twig by the peach twig borer is rather heavy and stops the growth of or kills shoots early in the spring.

The life history of the peach twig borer is similar in some respects to that of the oriental fruit moth. The borer passes the winter as a partly grown larva in a silk-lined cavity under loose bark, in crotches, in cavities in the trunk, and in similar places. The larva emerges in the spring and attacks the new tender shoots, which soon wilt and die. The mature larva is reddish brown or chocolate in color and may thus be distinguished from the larva of the oriental fruit moth, which is usually pinkish. There are one to four or more generations annually, the larger number occurring in the South.

CONTROL MEASURES

Spraying, just as the buds show pink, with either lime-sulfur in the proportion of 1 part to 10 parts of water or lead arsenate in the proportion of 3 pounds of powder to 100 gallons of water has been recommended for the control of the peach

twig borer. Burning the brush removed during the winter pruning will lessen injury.

SUCKING BUGS

Several species of sucking bugs cause scarring and distortion of peach fruit in different parts of the country. Under some conditions the losses are rather serious. Most of the injury is done when the peaches are very small, and the subsequent distortion of the fruit is out of proportion to the feeding that has actually been done. A few of the more important insects causing this type of injury will be discussed. Some of the injury attributed to the sucking bugs is caused by the plum curculio.

The leaf-footed bug and a related species frequently cause injury of this kind (fig. 18) in the South. They feed chiefly in the spring, although they may be on the peach trees throughout the season. These are long, narrow bugs, and their long hind legs have flattened enlargements, which suggest tiny leaves.

The green stink bug and the southern green stink bug sometimes cause serious damage to peaches. The adults feed on the fruit early in the season; and later the nymphs, or young bugs, also cause some injury. These species are among the largest of our native stink bugs. Both are green, although the southern green stink bug sometimes has a slight pinkish tinge.

Several species of large gray-to-brown stink bugs have been found to cause more or less injury to peaches in the Central West and probably cause some damage in other areas. They feed on peaches very early in the season, and are found on weeds or cover crops in or close to the orchard the rest of the year.

The tarnished plant bug occurs throughout the United States, and in the Central West and South has in some seasons caused deformed peaches. This bug hibernates in the adult stage, and in the early spring finds the buds, blossoms, and newly formed young peaches the most attractive food available. In feeding it appears to inject a poisonous secretion, which breaks down the tissue. Seriously injured peaches drop; others remain on the tree, but the affected areas later scar over and cause distortion.

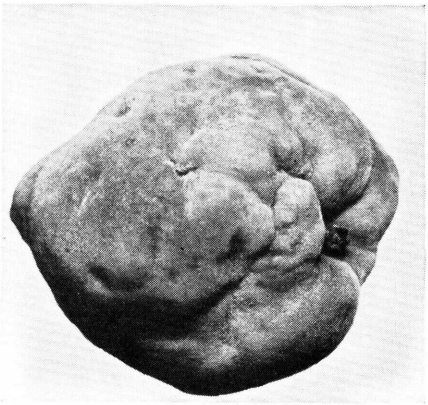

FIGURE 18.—Ripe Hiley peach showing the effect of attack by leaf-footed bugs several months before.

CONTROL

Injury by sucking bugs may be greatly reduced by application of a spray containing 2 pounds of 50-percent DDT wettable powder per 100 gallons at petal fall and again 8 to 10 days later. If parathion is used for plum curculio control, the second DDT application may be omitted. Some control of sucking bugs can be obtained by the elimination of cover crops that are attractive to them, such as sweetclover and alfalfa, from the orchard and its vicinity, and the reduction of weed growth in the orchard.

APHIDS

A number of species of aphids, or plant lice, are found on peach trees, feeding on the foliage of young shoots and in certain cases on the roots. Ordinarily these do not become abundant enough to require control measures, although occasionally serious damage is done. Three of the more important species will be discussed briefly.

The rusty plum aphid frequently damages the foliage of plum and young peach trees shortly after they put forth leaves, causing the new foliage to become distorted and crumpled by sucking out the food material. The pest may cause the terminal buds of the plum and young peach trees to become so stunted that growth ceases. A heavy infestation may kill the blossoms and prevent fruit from setting. These aphids are most common in home orchards that are not sprayed for other pests in the spring. The eggs, which are deposited on the small twigs in the fall, begin hatching about the time the buds open. The first few broods are wingless, but winged forms are produced later. These migrate to several varieties of grasses and there breed the rest of the summer. As cold weather approaches, winged forms return to the plum and young peach trees.

The black peach aphid attacks the twigs, shoots, and roots of peach trees and is often seriously abundant in the Middle Atlantic States. Some of the insects live throughout the year on the roots of the peach; others, however, migrate from the roots late in winter or early in the spring and start colonies on twigs and young shoots. Serious damage sometimes occurs to young orchard trees or to nursery stock.

The green peach aphid is a widely distributed species which occasionally becomes abundant on peach trees, although it has been of greater importance as a pest of other crops. As with the rusty plum aphid, the feeding on peach trees occurs chiefly in the spring or very early in the summer, and the species migrates to other food plants for most of the summer.

CONTROL

The rusty plum aphid and green peach aphid may be controlled by spraying the trees with three-fourths of a pint of nicotine sulfate in 100 gallons of water to which about 3 pounds of soap have been added. To be fully effective, this spray should be applied early in the season when the aphids first appear and before they have curled the leaves. The black peach aphid, which winters on the roots of the tree, may appear above ground at any time. In districts where difficulty has been experienced with this insect, careful watch should be maintained and an application of nicotine sulfate and soap made as soon as the insects appear. After the leaves have been curled, control is very difficult, if not impossible. *See* Precautions, p. 32.

SPRAYING AND DUSTING OUTFITS

For spraying peach trees around the home or in a small orchard, a bucket spray pump may be used. It should be made of brass or some other metal that will not corrode. A good type of bucket spray pump is shown in figure 19. It should be equipped with a 4-foot extension rod and at least 15 feet of hose.

The wheelbarrow sprayer is a convenient type for the home orchardist. The capacity is usually from 12 to 15 gallons, and it can be used for spraying a small home orchard if equipped with a 4-foot extension rod and 25 feet of hose.

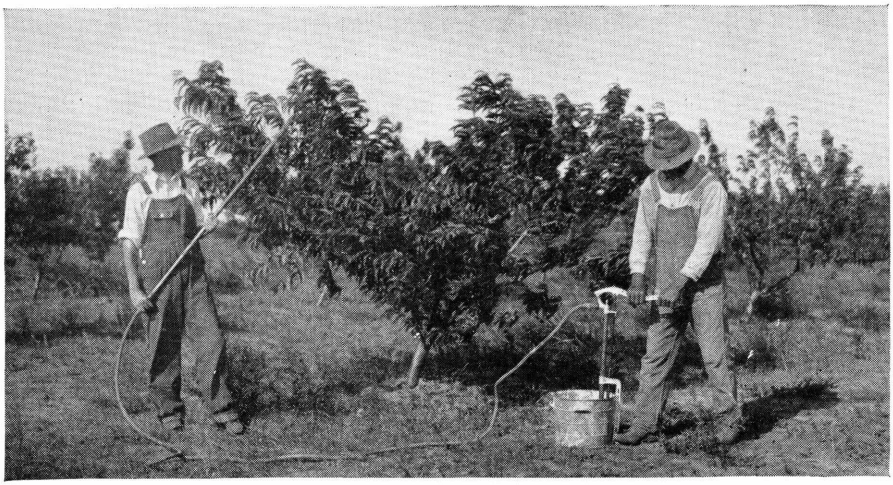

FIGURE 19.—Bucket pump for spraying a few trees.

For spraying orchards of 400 or 500 trees, a barrel spray pump (fig. 20) can be used. This pump fits into a 50-gallon barrel and develops from 125 to 150 pounds' pressure. It should be equipped with a 4-foot extension rod and at least 25 feet of hose.

A sprayer with a 50-gallon tank and powered by a gasoline engine to develop as much as 300 pounds' pressure can be used in peach orchards of 5 to 10 acres. It should be equipped with a 4-foot extension rod and from 35 to 50 feet of hose.

The standard power-spray outfit is the most satisfactory type of sprayer. It may be purchased in various sizes and should be used in peach orchards of 10 or more acres.

FIGURE 20.—A barrel pump.

It will develop 300 pounds' pressure or more, depending on the power of the motor, and will deliver 10 or more gallons of spray per minute. It is usually equipped with a spray tank holding 200 gallons or more, and 2 leads of hose 50 feet long should be provided.

Speed sprayers and other new types that develop high pressure or high air velocity are useful for spraying large commercial orchards. They are most commonly provided with a tank that holds 400 to 600 gallons. Some of them can be used to apply either dilute or concentrated sprays; others are designed specifically for applying concentrated sprays—that is, sprays containing two to eight times the usual amount of insecticide in a given quantity of water. So-called speed sprayers that apply dilute sprays have proved their worth, but machines for applying concentrated sprays are still in an experimental stage of development.

For dusting a few peach trees a hand duster consisting of a cylinder with piston rod for making an air blast may be used. However, larger hand dusters in which a fan is operated by cogs or a belt from a crank will be found more satisfactory and durable.

For dusting commercial or large home orchards a power duster should be employed. These outfits are driven by a 3- or 4-horsepower gasoline engine and can be regulated to discharge the desired quantity of dust.

INSECTICIDES

LEAD ARSENATE

Lead arsenate will control chewing insects, such as leaf-feeding caterpillars, the peach twig borer, and the plum curculio. It may be purchased in either powder or paste form, but the powder is more generally used. Lead arsenate is normally white, but as a safety measure it has in recent years been colored pink. The lead arsenate available commercially in the Eastern States is known chemically as acid lead arsenate. On peach trees powdered lead arsenate is ordinarily used at a strength of 2 pounds to 100 gallons of water (3 rounded teaspoonfuls per gallon). It should be made into a thin paste with water before it is added to the water in the spray tank.

Lead arsenate sometimes causes severe injury to the leaves, twigs, and fruit. Such injury may be reduced by the addition of 8 pounds of hydrated lime to each 100 gallons of spray. A finely divided high-calcium lime, often called chemical hydrated lime, is now available for use in spraying.

A better way of preventing arsenical injury is to add to all sprays containing lead arsenate, zinc sulfate at the rate of 4 pounds per 100 gallons of spray. *Zinc sulfate should never be used without an equal quantity of lime.*

OIL SPRAYS

Oil sprays are used for the control of the San Jose scale and other scale insects. They are available as emulsible oils and as lubricating-oil emulsions. The stock lubricating-oil emulsions are white to creamy in appearance and vary in consistency from that of thin cream to a stiff pasty mixture resembling mayonnaise. Stock may be bought in prepared form or may be made on the farm.[4] The oil content ranges from 50 to 90 percent, the most commonly used formulas containing approximately 67 to 83 percent of oil.

[4] Formulas and directions for the preparation of oil sprays may be found in Farmers' Bulletin 1676, Lubricating-Oil Sprays for Use on Dormant Fruit Trees.

Quantity of stock lubricating-oil emulsions to make sprays of different strengths

Oil content of stock emulsion (percent)	Gallons of stock to make 100 gallons of spray		
	2 percent	3 percent	4 percent
50	4	6	8
65	3¼	4¾	6¼
80	2½	3¾	5
85	2½	3¾	4¾
90	2¼	3½	4½

Emulsible oils include miscible, soluble, and emulsive oils, and contain one or more oil-soluble emulsifying agents and little or no water. They commonly contain 95 to 99 percent of oil and are similar to lubricating oil in appearance. Some of them, particularly those often called miscible oils, mix readily with water with little or no agitation, and others, those described as quick-breaking, require strong agitation for proper mixing. The former are easier to use, but the latter are more effective. Emulsible oils should be diluted and used in accordance with the directions found on the container.

LIME-SULFUR

Lime-sulfur is an old remedy for the San Jose scale, which is also used for the control of the white peach scale and the peach twig borer. The solution can be purchased from manufacturers or can be made on the farm. The concentrate should test 32° or 33° Baumé, and for peach twig borer control should be used in the proportion of 1 part of concentrate to 10 parts of water.

Lime-sulfur may also be purchased in the dry form, in which case it should be used in accordance with the manufacturer's directions.

PARADICHLOROBENZENE

Paradichlorobenzene, often called para or PDB, is used chiefly for the control of the peach tree borer. It is a white crystalline material, insoluble in water, with a characteristic odor irritating to the mucous membrane of the nose. It vaporizes slowly at ordinary fall temperatures (60° F. or above) and very little at lower temperatures, and the vapor is somewhat heavier than air. The gas is deadly to insects confined in it, but when used as recommended is not poisonous to man or domestic animals.

Orchardists are strongly advised to use only unadulterated paradichlorobenzene and, when ordering, to specify a grade of about the fineness of granulated sugar, or small, thin, flaky crystals.

ETHYLENE DICHLORIDE

Ethylene dichloride, used for control of the peach tree borer, is a colorless liquid with an odor like that of chloroform. It is heavier than water and vaporizes freely at ordinary temperatures. The vapor is heavier than air and penetrates the soil readily. The chemical is only slightly soluble in water and burns with difficulty when ignited by a lighted match. When the vapor of ethylene dichloride is inhaled, it has an anesthetic action, although one that is less rapid than that of chloroform. Unless breathed in high concentrations over a protracted period, no harmful results need be feared in working with this compound. Long-continued contact with ethylene dichloride has been reported to cause some skin irritation.

Commercially prepared emulsions are available on the market, and the packages bear directions for dilution and use. If you wish to prepare the emulsion at home,

use 9 parts of ethylene dichloride, 1 part of potash fish-oil soap, and 8 parts of water (all parts by volume). Since the compound boils at a temperature below the boiling point of water, do not use heat in making this emulsion, and keep the liquid away from fire. The air temperature should be between 50° and 80° F. To avoid breathing undue concentrations of the vapor, prepare the emulsion outdoors or in a well-ventilated room.

Use a good grade of potash fish-oil soap—that is, one without an excess of caustic potash and with approximately 30 percent of actual soap. Put the soap into the mixing vessel and add the water slowly, stirring until the soap is well dissolved. Then add the ethylene dichloride and emulsify cold by pumping the mixture into another container.

Another method is to place the soap in the mixing container and add ethylene dichloride a little at a time, with constant stirring. When the soap and ethylene dichloride are thoroughly mixed, add the water slowly with constant stirring.

The stock emulsion made by either method contains 50 percent of ethylene dichloride. It should be further diluted with water just before it is used, the amount of dilution depending on the age of the tree and the dosage required. *See* p. 14.

If the stock emulsion breaks down after being prepared, there is formed a curdled mass or a layer of clear ethylene dichloride on the bottom, which cannot be readily remixed by moderate agitation. The material must then be reemulsified by pumping the mixture from one container to another or back into the same container, or by starting over again with a small quantity of potash fish-oil soap to which small quantities of the broken emulsion are added slowly at intervals with constant stirring.

NICOTINE SULFATE

Nicotine sulfate is a thick, brown liquid that is frequently employed for the control of soft-bodied sucking insects such as aphids. The form usually available on the market contains the equivalent of 40 percent of nicotine. For best results it should be used with some alkaline material, such as lime, or with soap in order to liberate the nicotine. Soap also assists in wetting the bodies of the insects, thus improving the control obtained. *See* Precautions, p. 32.

CRYOLITE

Cryolite is a white, crystalline material that is available in both the natural and synthetic forms. The two forms are about equally effective and are useful for controlling the plum curculio in southern peach orchards after the crop is harvested. As a spray to control the curculio, cryolite is used at 4 pounds to 100 gallons of water. Cryolite should not be mixed with lime and should not be applied to peach trees until the crop has been harvested. *See* Precautions, p. 32.

DDT

DDT has come into widespread use both as a contact insecticide and as a stomach poison. It is valuable to the peach grower for controlling the oriental fruit moth, the peach tree borer, the shot-hole borer, sucking bugs, and leaf-feeding insects. Affected insects do not die quickly. DDT spray deposits are very persistent. In general, it is relatively nontoxic to plant foliage.

DDT is available in many formulations, but only the wettable-powder formulations are much used on peaches. For most uses 2 pounds

of a 50-percent wettable powder, or its equivalent, to 100 gallons of water is recommended for control of most peach insects, but as much as 8 pounds of this powder may be recommended for controlling the peach tree borer. *See* Precautions, p. 32.

PARATHION

Parathion is of value for controlling the plum curculio, oriental fruit moth, scale insects, the peach tree borer, the lesser peach tree borer, and some other insects that attack peaches. It is available in various formulations, but for spray applications the 15-percent wettable powder is most commonly used at ½ to 2 pounds to 100 gallons of water, depending on the pest. Occasionally it is used as a 1-percent dust. *See* Precautions, p. 32.

EPN

EPN is closely related to parathion, but less volatile. It can be used to control the plum curculio, the oriental fruit moth, the peach tree borer, and the lesser peach tree borer, and is an excellent miticide. EPN is generally available as a 25-percent wettable powder, which is usually used at the rate of 1½ to 2 pounds to 100 gallons of water. As little as ½ pound to 100 gallons will control mites. *See* Precautions, p. 32.

BHC

BHC (benzene hexachloride) can be used to control the peach tree borer, and is also of value against grasshoppers, sucking bugs that cause deformed peaches, the plum curculio, and aphids. Its effectiveness is due to the gamma isomer, and recommendations for its use are based on its gamma-isomer content.

BHC is available in dusts, wettable powders, and emulsifiable concentrates. Wettable-powder formulations containing 6 to 12 percent of the gamma isomer are most commonly recommended for use in sprays to be applied to fruit trees. From 3 to 4 pounds of a 6-percent gamma powder, or its equivalent, should be used to make 100 gallons of spray for most purposes. A larger quantity is required for the control of the peach tree borer. Dusts containing 1 percent of the gamma isomer are used occasionally for plum curculio control.

BHC has a persistent disagreeable odor, and it may impart an objectionable flavor to foodstuffs. It should therefore be used only early in the season, or for special purposes, such as application to the trunks of the trees, but not to the fruit. *See* Precautions, p. 32.

ZINC-LIME SPRAY FOR BACTERIAL SPOT

Where bacterial spot is a serious problem, a spray containing 8 pounds each of zinc sulfate and hydrated lime to 100 gallons of water is recommended. Six or seven applications at 2-week intervals, beginning at petal fall, are necessary.

To prepare the spray, fill the tank nearly full of water, start the engine to give agitation, and add the zinc sulfate. If the lumps have been well broken up, it will dissolve in less than 5 minutes. Mix the lime with a small quantity of water to form a thin paste, and when the zinc sulfate has dissolved, wash this paste through the strainer into the tank. Finish filling the tank, and agitate for 5 minutes or more before beginning to spray. By agitating, it is rather easy to keep the white precipitate from settling. Use at once.

Store zinc sulfate in a dry place. There is some risk of heating and spontaneous ignition if it is allowed to absorb moisture.

PRECAUTIONS

All the insecticides discussed in this bulletin are poisonous. Handle them with care. Follow the precautions on the label. Store them in plainly marked containers away from all food products and where children and domestic animals cannot reach them. When mixing and applying insecticides, take care to keep them out of the mouth and eyes and away from the tender parts of the body. Wash the face and hands thoroughly after applying any insecticide. After long exposure take a bath and change clothes. Wash clothing on which spray residues have accumulated before wearing it again.

Parathion and **EPN** are very toxic to human beings if swallowed, inhaled, or absorbed through the skin. Do not use them unless you are willing to observe the recommended cautions. Handle them with care and only in the open air or in a well-ventilated room. Avoid breathing in the wettable powder while opening the bags or putting it into the spray tank. Avoid exposure to spray drift or dust clouds; wear protective clothing if so exposed. While handling the materials and during spraying or dusting wear a respirator of a type that has been tested in the Department of Agriculture. Never handle formulations of these materials with the bare hands. In case the spray strikes the face or arms or the clothing becomes wet, remove the clothing immediately and wash thoroughly the exposed parts.

If headache, blurred vision, weakness, nausea, cramps, diarrhea, or discomfort of the chest develops while working with these materials, or in or about trees sprayed with them, stop work immediately, change the clothes, and bathe. If the illness persists, call your doctor. Atropine in therapeutic doses is of value in relieving acute symptoms of poisoning from these insecticides.

Nicotine sulfate causes nausea in some people upon exposure to fumes from either the undiluted or diluted material. Acute illness can result from its absorption through the skin. If you spill the concentrate on the skin, wash it off immediately. Do not continue to work in clothing that has become saturated with nicotine spray.

Avoid Pesticide Residues

No fruit showing insecticide residues should be offered for sale, no matter how harmless the residues may be. It is very important that no lead arsenate be applied within 4 weeks and no parathion or EPN within 3 weeks before the probable ripening date of each variety. Later applications of poison or a greater number of applications of lead arsenate than are recommended may result in excessive poisonous residues on the fruit at harvest time. The last applications should be light to avoid unsightly residues on the picked fruit.

If, in spite of these precautions, residue is in evidence when the peaches are harvested, it may be removed by running the fruit through a brushing machine. Equipment of this type is available in most modern packing houses.

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